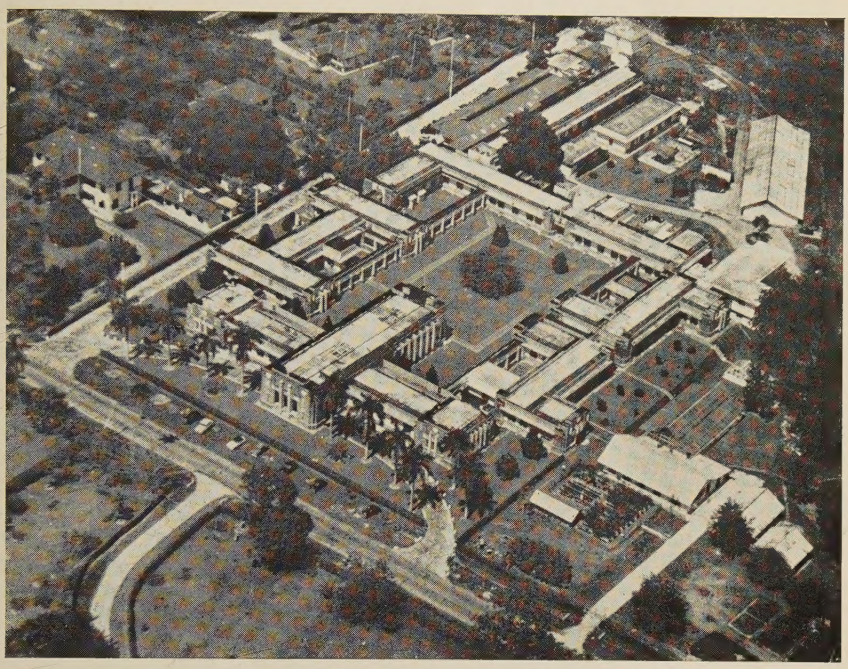
PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA



NEW SERIES NUMBER TWENTYSIX

CONTENTS

	Page
Editorial: Theory and Practice	79
Cockchafers	81
Correct Timing	85
Water Conservation	88
Mulching	90
Recent Advances with Latex	93
R.R.I. News, Notes, Correspondence	96

Price
50 Cents

September
1956

R R I

LOCATION. The institute's laboratories and offices are at the third mile, Ampang Road, Kuala Lumpur.

CORRESPONDENCE. All LETTERS must be addressed to the Director, Rubber Research Institute of Malaya, Post Office Box 150, Kuala Lumpur. Special inquiries may be marked for the attention of particular officers. The address for TELEGRAMS is Searching, Kuala Lumpur. TELEPHONE: Kuala Lumpur 3351. PARCELS occasionally arrive without any indication of their origin. Senders' names and addresses should be written clearly on the outside of all packages, and the institute should be advised of despatch by letter or telegram.

PROHIBITED PLANT SPECIMENS. Attention of planters and others in territories outside the Federation of Malaya and the Colony of Singapore is drawn to the Malayan Plant Importation Rules which prohibit the importation into Malaya of any part of a plant, whether living or dead, unless it is accompanied by a permit issued by the Director of Agriculture, Federation of Malaya. No permit will be issued in respect of any diseased plant or any plant pest. Any plant imported in contravention of these Rules (whose object is to prevent the introduction of diseases or pests) will be destroyed without examination. Anyone outside Malaya who desires our advice on any matter that may require examination of living material must first inquire by letter.

ADVICE. Inquiries are invited from rubber producers in the Federation of Malaya, the Colonies of Singapore and North Borneo, and the territories of Sarawak, Brunei and Nigeria, who may require more detailed information applicable to their own special problems. Where it is considered necessary, visits will be made to Estates in Malaya as convenient. Visits to estates in other territories are by special arrangement. The only visits for which charges are normally made are those of the Institute's budding mandores. INTERVIEWS should be arranged by letter or telephone, as members of the senior research and advisory staff are frequently absent on visits to plantations. The institute is open from 8 am to 1 pm and 2 pm to 4 pm on Mondays to Fridays, and from 8 am to 12.30 pm on Saturdays.

EXPERIMENT STATION AND FACTORY. This station of the R R I is situated 16 miles from Kuala Lumpur, at Sungei Buloh on the Kuala Lumpur — Kepong — Kuala Selangor road. Visits may be made on Mondays or Wednesdays by arrangement. There is a guest house.

PUBLICATIONS. A list of 'Publications of the R.R.I.' is available on request. Subscription may be made by depositing $15 with us. An annual statement of account will then be submitted.

PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur September 1956 Number 26

Editorial: Theory and Practice

When scientific advice is given in any field of industry or agriculture the recipient is apt to find that the advice is too conservative and that a clear unqualified statement is seldom provided. The application of science to rubber planting is no exception. Scientific advice must always be supported by evidence derived from properly designed experiments and must necessarily be conditional because of the uncontrollable variables which are encountered in every biological problem. An experiment laid out at a particular place, under a particular set of conditions, may provide relatively straightforward results. These results, however, must be modified when advice based on them is made available over a wide range of economic and environmental conditions. Variations in estate practice, in quality of labour and supervision, in the cost of production and in the price of rubber must all be taken into account before advice can be offered on the problems of any particular estate. The difficulty can be partially overcome by repeating the same experiments under a number of the more easily recognised sets of conditions but it is impossible to cover all possible variations.

An unfortunate consequence of the feeling that scientific advice it too conservative is that plausible theories are seized upon as offering spectacular advances on established practice. Some of these theories appeal to common sense when they come from practical men who claim to have made new observations which revolutionise the approach to their subject. Sometimes the theorist admits that his basic observation is not original but asserts that it has been overlooked or neglected in the past. Claims of this sort are usually quite unfounded and stem from the fact that the theorist has not obtained access to the previous work carried out on his subject. The planters to whom the theory appeals have no ready access to the previous work themselves, and if the assertions are made in a forceful manner they may be accepted without question. Once he has been seduced into accepting a faulty premise the planter may allow himself to be led through a series of seemingly logical arguments to a false conclusion.

Scientists who publish scientific papers on their work must be careful to state not only what they claim to have proved or observed but also the methods by which they tackled their problems and by which they reached their conclusions. They must be prepared to produce the facts and figures by which other scientists can be convinced of the accuracy of the work, to repeat it if they wish. Communications to our own scientific record, the *Journal of the Rubber Research Institute of Malaya*, follow these strict requirements and also include detailed references to work done elsewhere.

When advice based on such investigations is published — as in this *Planters' Bulletin* — the technical details and the great mass of figures involved in the underlying work are omitted. The volume of experiments and their records which lie behind a simple piece of advice in *Planters' Bulletin* is often considerable. Our advice is accepted as authoritative largely because all the basic facts and figures are available to any bona fide inquirer.

This proviso should hold for any article which purports advice to the rubber planter. Opinion should never be given as fact, and generalisations should be backed by some account of the results on which they are based. The limitations of results obtained under individual and possibly special conditions should not be ignored. Above all, the author should be prepared to substantiate his finding with full facts and figures. This does not gainsay the value of opinion based on long and wide experience, but means that theory should be presented as such.

The theories with which planters are confronted may cover any of the problems of rubber planting but those which hold out the promise of increased profit as a result of earlier maturity, or of increased yields, are the most attractive and yet the least likely to be sound. Such important aspects of planting have been the subject of considerable experimentation in this and other rubber producing countries and, while the present orthodox methods of husbandry cannot be considered incapable of improvements, any changes are unlikely to be spectacular.

Should a planter change his methods on the strength of a forcefully presented theory he is likely to be disappointed. Firstly, it is impossible to take into account the many interacting factors which operate, without conducting a statistically designed experiment. Secondly, assuming that the theorist has made fair deductions from his personal and subjective observations, there remains little likelihood that the same results could be achieved on all other estates. Thirdly, the theorist has probably omitted to give sufficient detail of method to enable others to follow his technique closely. Fourthly, the costs of the new technique are unlikely to be realistic if they are given at all.

The costs of a new method of husbandry are of vital importance. A gardener can grow a few rubber trees much more quickly than is economically possible on an estate. In the same way an enthusiastic planter, who is trying out an idea of his own, can achieve surprising results when he is giving one of his problems his particular attention. Any success is as likely to be due to excellence of supervision as to improvement in method. The cost of that supervision is not taken into account.

The methods of techniques at present in use on rubber estates in Malaya have been established by practice over many years or by carefully controlled experimentation or by a combination of both. Many of the advances in the past have been the result of a stimulation of ideas brought about by discussion and theorising. But a great many apparently sound theories have been proved to be fallacious, when put into practice under a variety of conditions.

Theories on problems of estate management, whether voiced in discussion, or presented in print, serve a very useful purpose in focusing attention on matters which might otherwise be neglected or taken for granted. The danger lies in the premature acceptance of the theories before they are proved to be based on fact and economic in application.

Cockchafers

AN ENTOMOLOGIST WOULD SAY that cockchafers are beetles of the Melolonthid and Rutelid families. They are more familiar as the May bugs and June beetles of temperate lands — these months being the flighting periods when the beetles are most conspicuous. In Malaya we are concerned mainly with three distinct species only, as pests of the rubber plantation, and they are shown in *Figure 1*.

The beetles are mostly large, thickly built, horny and strong. They have a powerful flight, taking to the wing for a short time about dusk and dawn. The flighting of cockchafers is connected with their mating habits and, of course, aids dispersal. During the day they remain inactive in the soil or amongst foliage. At night they feed on leaves; in this way a few are destructive pests. Most of the damage done by cockchafers is as grubs in the soil, feeding on roots.

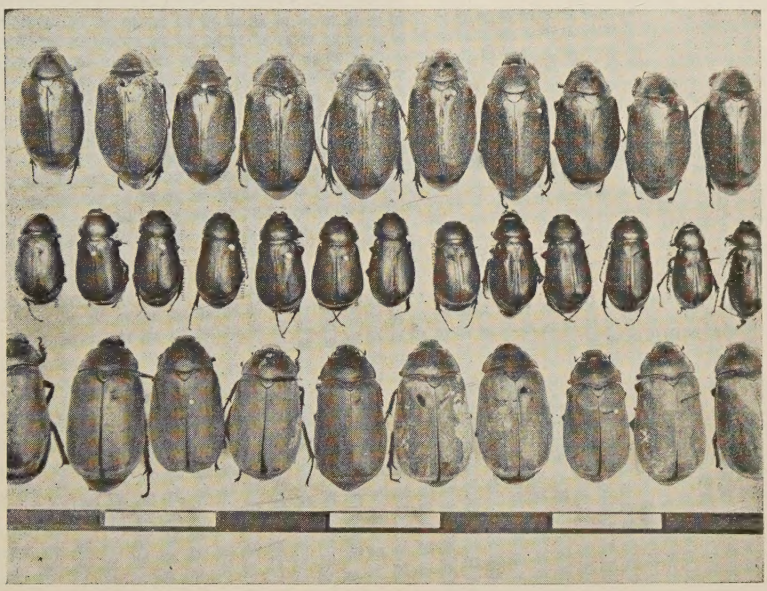


Figure 1. The three species of cockchafer beetle which, in the grub stage, are injurious to rubber plantations. From top to bottom: Leucopholis rorida, Holotrichia bidentata, Psilopholis vestita. The scale is in inches.

There are many species that are pests of rubber plantations in Malaya and nearby lands, but here we shall consider only the three main ones — *Leucopholis rorida, Psilopholis vestita* and *Holotrichia bidentata,* all Melolonthids. Less important but more conspicuous are the vivid green and copper beetles belonging to the Rutelid genus *Anomala.* For the most part cockchafer beetles are sombre in colour. *Leucopholis* is brown flecked with minute yellow scales, with four rows of slightly larger ones on each wing cover, while on the underside the scales are hair like.

The *Psilopholis* beetle, also brown, is larger and has a more uniform clothing of fine hairs giving it a dull appearance. *Holotrichia* is a much smaller beetle, reddish brown and shiny. The grubs of these and other species can be identified by examining the distribution of certain bristles, but to do this reliably requires expert knowledge.

LIFE CYCLE

The life cycle of cockchafers is a long one, extending over several years in temperate regions. In the tropics they have an annual cycle; the high temperature enables them to develop faster, while the lack of well defined seasons results in considerable overlapping of the different stages. Generally, in Malaya, the beetles emerge during the early months of the year. The females lay their eggs singly, or in clusters (*Figure 2*) in the soil, which they burrow into for this purpose, showing a preference for light, sandy soils. When the eggs are ready to hatch they are much swollen from the size when laid. The grubs which hatch out live entirely in the soil, eating away the finer rootlets that they encounter as they move about, and stripping the bark from larger ones. By the second half of the year they are big enough to be seen easily if the ground is dug over. The body is incurved, thick and fleshy, with three pairs of short legs (*Figure 3*); white at first, becoming yellowish in the later stages. The hind end appears dark because gut contents show through the transparent skin. The head is hard and brown, with powerful jaws. When the grub is fully fed it builds a smooth walled cell in the ground, where it remains quiescent for some weeks before pupating. The adult beetle that emerges from the pupa also rests for a period in the soil, the moment when it takes to the wing being influenced by climatic factors.

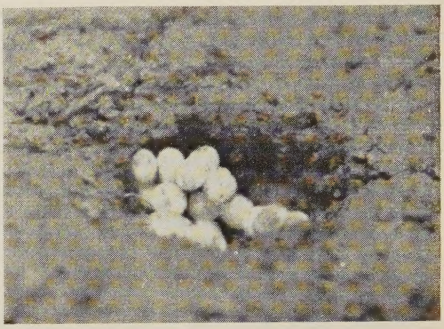


Figure 2. Exposed egg cluster of Psilopholis vestita, laid in a cavity in the soil. Natural size.

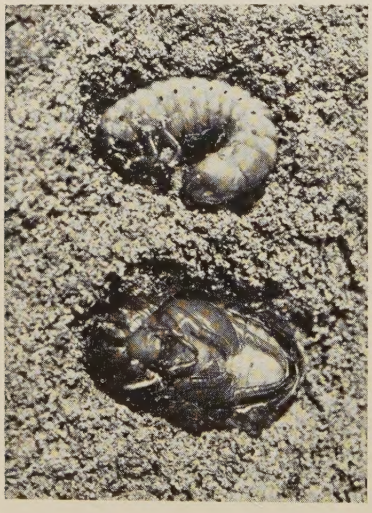


Figure 3. Grub and pupa of Holotrichia bidentata exposed by digging. Natural size.

Full details of the life histories of these pests in Malaya have not,

however, been fully worked out. Grubs collected in the field can easily be reared in the laboratory, but adults that emerge in captivity do not mate and any eggs the females lay are sterile. If the pests assume greater importance, the life histories will be further studied by collecting large numbers of females, some of which will have been fertilised before capture and will therefore lay viable eggs. In general it may be said that both the egg stage and pupal stage last between about two weeks and a month; the grubs are feeding for only about half the year. The remaining parts of the year are spent in resting before and after the pupal stage. Climatic changes must influence if not control the duration of the resting phases, so that the cycle recurs annually.

OUTBREAKS IN MALAYA

Outbreaks of cockchafers have had a curious history in Malaya. Until 1930 the pests were almost unknown; from then on there was a steady build up until 1938, after which the outbreaks diminished. The decline presumably continued during the years of Japanese occupation, for by 1947 the pests had largely disappeared. Several explanations have been offered to account for this sequence of events. The increase may have been due to increased replanting in those years, or to the changeover that took place about then from clean weeding to 'forestry' methods of cultivation. On the other hand, we should perhaps look for the cause in the jungle, whence the pests came. Large variations in the abundance of wild populations (sometimes cyclical) are not unusual among insects that have a long developmental period. A high density in the jungle may have caused the pests to overflow into nearby lands.

The natural enemies of cockchafers, other than the birds and beasts which eat the beetles and grubs, are parasitic wasps, flies and fungi. The wasps are considered of most importance. The female wasp digs into the soil to locate a grub, stings it and lays an egg on it. When the parasite larva hatches, it feeds by sucking the fluid out of the paralysed cockchafer grub, and afterwards pupates near the remains of the host. Unlike the wasp, the larva of the parasitic fly bores its way into the grub and feeds inside. The host remains active for a while, but in the end is completely devoured, and the parasite pupates inside its skin. As the parasites themselves have enemies, the biological control of cockchafers (as of most other insect pests) is complex.

Possibly cockchafer grubs are not much parasitised in rubber plantations because of the lack of flowers on which the adult parasitic wasps feed. On the other hand, cockchafers are unlikely to become permanently established in rubber plantations on any considerable scale because there would be insufficient food for the beetles. Certainly they do not feed on rubber leaves. Should the occasion call for it, the feeding of the important pest species and of their parasites would be studied, for there might be scope for influencing the biological balance in an outbreak area by eliminating plants on which the beetles feed, while introducing others that attract the parasitic wasps.

Cockchafer outbreaks which have come to our notice on rubber plantations in more recent years have been few and localised. We are prepared at any time to find that a new wave of activity is starting, but

there is no clear evidence for it yet although several independent outbreaks were recorded last year. The reports that we receive, however, do not necessarily reflect the actual incidence in the field. Thus, investigation of a recent report showed that a similar outbreak had occurred in the same area in each of the last few years.

Before the war the principal cockchafer pest was *Psilopholis vestita*, which it has been said is more a pest of the plantation than of the plant. For several years after the war the cockchafers encountered were other species, but in 1950 an estate in Kedah experienced an outbreak of *Psilopholis* as had occurred previously. The pests had flown out of nearby jungle across a small ravine, and had laid their eggs in a steep hillside under nineteen year old rubber. Later in the year the grubs had destroyed the natural covers completely. Soil wash started and was much accelerated by the activity of wild pigs avidly searching out the grubs for food. Extensive repairs to the contour terraces and the digging of silt pits saved the soil. The pigs — or some other agency unknown — disposed of the pests, which did not reappear in subsequent years.

On most recent occasions the cockchafers encountered have been chiefly *Leucopholis rorida*, which is definitely a pest of the plant. If grubs are present in the soil of nurseries established in the latter months of the year when the grubs are getting large, the damage can be considerable. The plants, being small, are quickly killed — the tap root eaten away nearly to soil level; also, being close together, neighbouring plants are soon destroyed in their turn. Because the attack is made immediately obvious by the injured plant falling over, the grub that did the damage can be found by digging at that point without delay. Control has been achieved in this simple way. Like damage can occur in field plantings, where the area is heavily infested. By the time an outbreak of cockchafers is recognised, the grubs are usually nearly ready to pass into the quiescent, prepupal stage. Caution is therefore necessary in judging the effects of insecticides applied at this time. Unless untreated plots are left for comparison, an erroneous impression of effectiveness is likely when in fact the treatment has been put down too late to have any effect at all.

Our experience has been that *Leucopholis* outbreaks in seedling nurseries and first year field plantings do not recur in the same place the following year. On the other hand, an area in Kedah is known where a low level of infection with *Leucopholis* has been maintained for many years in old rubber which is (perhaps as a consequence) in very poor condition.

Outbreaks of *Holotrichia bidentata* have been different again, for this species appears to be more a pest of covers, many acres of which have in one or two instances been severely retarded or even totally destroyed in places. There is no evidence that the pests persist in the area.

CONTROL

Apart from possible ways of encouraging biolgical control, as already discussed, outbreaks of cockchafers can be combatted by collection or by using chemicals. Hand collection was for a long time the only method to be used with success in the field, laborious though it was. In the

outbreaks in the 1930s vast numbers of grubs were dug out of the soil, and adults were collected from foliage or from the ground for destruction. Light traps were also used to catch the beetles, but more males are caught by this method than females, even though the sexes are about equally numerous in nature. In Java *Leucopholis* beetles used to be collected during the evening flight by means of stones smeared with chillies, but again only males were caught. Picking beetles out of foliage where they were resting during the day was found to yield mostly females that had already laid their eggs. Since the aim of collecting beetles is to reduce the amount of egg laying, it is seen that the various methods have snags apart from the magnitude of the task.

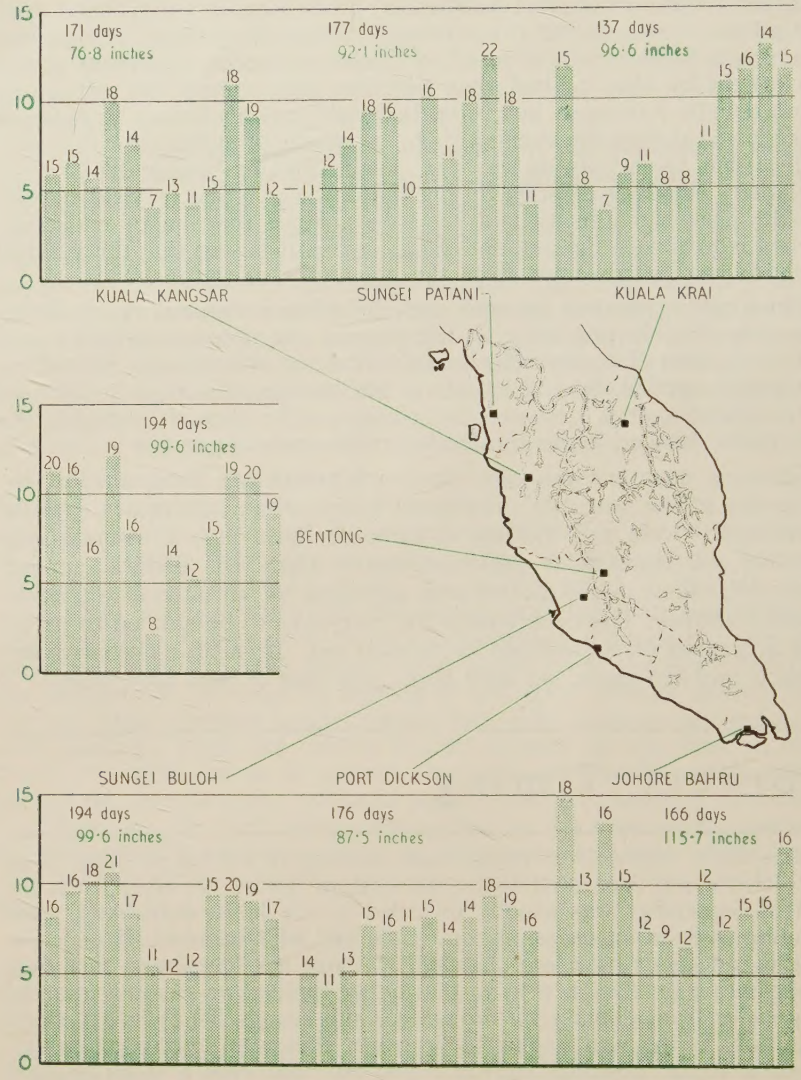
Chemicals applied to the soil must be either poisonous or repellent. The only feasible procedure at the time of the prewar outbreaks was soil fumigation. Experiments demonstrated the effectiveness of carbon disulphide applied by soil injectors, but serious objections to its use were apparent. It is poisonous to plants and to man; it is highly inflammable; further, it was too costly for commercial practice.

There is now fair prospect that cockchafers can be controlled by using one of the synthetic chlorinated hydrocarbon insecticides recently developed. Aldrin and dieldrin in particular have proved astonishingly effective soil insecticides against termites. Last year dieldrin applied round the plants in an affected area appeared to put an end to a cockchafer outbreak. The need now is for outbreaks to be notified to us, so that a method of control can be worked out. Then, if cockchafers become a problem again, we shall know how best to deal with them.

Correct Timing

IT HAS BEEN SUGGESTED TO US that planting of rubber is being done later nowadays than used to be the custom before the war, when the end of September was usually regarded as the latest date. At present planting is done on occasions up to the end of December. If meteorological conditions have not changed, we have the impression that such late planting involves a risk, in that either budded or seedling material may suffer from damage by drought or sun scorch. The effect of those conditions is too well known to be worth elaborate description herein; at worst whole plantings can be wiped out, and even a slight drought can cause a number of casualties requiring supply.

An examination of recent meteorological records seemed to be required, to discover if any change of weather had caused this shift in the planting season. Rainfall summaries of seven stations in or near the major rubber growing areas for every month of the year for five years are shown in the diagram. Before proceeding to discuss these data, we have to point out that the histograms represent only an average and do not show the effect in an abnormal year, such as 1950 when drought was experienced in some states. They do however assist us in drawing conclusions as to the most suitable planting months of the year on the average.



Meteorological data, averaged for the years 1950-55. The green pillars show monthly rainfall in inches, from January to December, for each locality. The total days of rain for each month is given over the corresponding pillar, as a number in black. Annual totals appear above each histogram : number of days (black) and rainfall in inches (green).

The histograms show that rainfall is at its lowest in June, July and August, when also the numbers of days of rain per month are at their lowest. When growing either seedlings or buddings it is obvious that not only is a good rainfall required, but also a good distribution of rain

throughout the month. The month with the highest rainfall is October and this month also has the largest number of rainy days. It also appears that between the low rainfall and small number of days of rain in August, and the high rainfall and the large number days of rain in October, there is an increase which commences during September.

It seems reasonably obvious therefore that planting of clonal seedlings or unselected seedlings is best done towards the end of September to take the fullest advantage of the heavy rainfall in the month of October. On the average, such timing should give the most successful plantings.

With regard to buddings, again it appears that budding during the first or second week in September will enable buddings to be cut back early in October, thus taking advantage of weather conditions. Such practice will allow the young material to establish itself during the months of October to April, ready for the periods of low rainfall in May to August. Planting in December leaves out three months of the establishment period and the young material is less well developed and less resistant to droughts which may occur during the summer.

The month of April is usually considered to be the second planting season, but it is quite obvious that material planted in the end of March or early April does not have the advantages of that planted later in the year, and must encounter the three dry months of summer after only two and a half months' growth in favourable weather. Although April has a reasonably high rainfall and a reasonable number of days of rain, planting should not be done to take advantage of this month, except as a matter of expediency.

The exception to this generalisation is the east coast of Malaya, as the columns for Kuala Krai in the diagram show. Here the seasonal climate caused by the monsoon makes September a fair month for planting, and planting or budding can possibly be done in August. On the other hand the reasonable meteorological conditions experienced in other parts of Malaya in April are not apparent on the east coast. To attempt any form of planting during December in this area would be disadvantageous.

In the north of Malaya, the months of January, February and March appear to have a low rainfall when compared against the same months in central Selangor and south Johore. On the other hand conditions during these months in the Port Dickson area approximate to those in north Malaya.

No attempt is made in this short article to consider the effect of local topographical conditions, such as the excessive rainfall at Taiping on account of the close proximity of the hills, and the sea breezes experienced on the west coast, which even out the rainfall. Local conditions will be known to the managers of estates in the particular areas concerned.

Throughout the whole of the country, however, it appears to be a safe general rule that planting should be done as early during September as possible, to take advantage of the October rainfall. Planting to take advantage of the April rainfall should be avoided wherever possible.

Water Conservation

THE WATER REQUIREMENTS OF PLANTS vary considerably. Some plants are adapted to arid conditions and can withstand drought but others require a fairly continuous supply if they are to grow well. Hevea is a tree of the tropical rain forest and needs a heavy and evenly distributed rainfall. In Malaya the rainfall is sufficiently heavy to ensure that, if the rain were to fall continuously, trees should at no time suffer from lack of water. The rainfall is fairly evenly distributed throughout the year, except in the north. However, throughout Malaya there are periods when the growth of the rubber is retarded due to lack of water. As is to be expected, these drier periods can do the most harm to young trees which have a shallow and limited root system. Certain cases of shoot dieback and defoliation in older trees have been attributed to drought. A point of interest is the well known connection between the day to day variations in yield and the rainfall.

This is the problem: rubber trees do suffer from lack of water during short periods but the rainfall at other times is more than sufficient. Water conservation is the storing of water from such heavy rain so that it will be available to the trees in a subsequent drier period. Water can be stored in two ways, either *in situ* in the soil or elsewhere as in a river or a dam. This second form of storage is of minor importance in the rubber industry because of the expense of transporting the water to where it is required. The transport of such water is only worthwhile for watering nurseries and, occasionally, young trees in the field.

The more usual method of water conservation is to store the water in the soil. Now a certain proportion of the rain will penetrate the soil and remain within rooting depth for the plants to use. The methods of water conservation are directed towards increasing the amount of water thus stored by decreasing transpiration and evaporation and by minimising run off. Some water is lost by percolation to depths to which the roots do not penetrate or by lateral movements through the soil into a drain or stream but there is no practical way of reducing loss of this nature. In coastal clay areas and in some depressions or valley bottoms on inland soils drains have to be dug to improve soil aeration. Damming such drains to conserve water would conflict with the original purpose for which the drains were dug.

METHODS OF WATER CONSERVATION

The first method of water conservation to be considered is that of reducing transpiration from covers between the rows. Eradication or slashing of these covers can be considered as a method of water conservation, but is probably not justified on that ground alone. These operations are usually carried out to reduce competition for nutrients and light and to help the tapping panel to dry out after rain.

Another, and a more important aspect of water conservation is that of reducing evaporation from a soil surface that has to be kept clear of weeds. This is done by mulching, a procedure which will not be discussed here as it is the subject of another article in this issue.

The third method of water conservation involves improvement of the structure of the surface soil and thus increasing the proportion of water that penetrates rather than runs off. Much of the rain in Malaya

falls during heavy storms in which the intensity of the rainfall may be as high as two or three millimetres per minute. Such rain, on soils where the permeability of the surface is low, cannot be absorbed completely.

Both a growing cover and a mulch can increase the permeability of a soil. A cover can improve the structure of a soil by the physical action of its roots which penetrate and loosen the earth, and also by the return of organic matter to the soil in the form of leaf litter. The leaf litter is broken down to form humus which plays an important part in stabilising soil crumbs. The leaf litter or the soil organic matter is used as food by earthworms and the various species of termite that live on dead plant residues; these animals produce a large number of tunnels in the soil which contribute to the permeability. A further function of a cover is to protect the soil from the compacting effect of raindrops. Anyone who has walked in a heavy thunderstorm will realise that large raindrops have quite a lot of energy; when such raindrops hit exposed earth they break up the rather fragile soil aggregates into finer particles and often puddle the surface layer of soil. This effect produces a crust of compact wet soil through which water cannot pass quickly. In many soils this dries out to produce a hard crust that can easily be recognised. Obviously a cover, if thick enough, will protect the soil How much a cover can improve soil permeability can be judged by the results of some experiments which have shown that a vigorous creeping cover can increase the permeability of the topsoil about a hundredfold. A cover can both assist and oppose water conservation, for though it may improve the penetration of water into the soil and thus increase the amount stored, a cover will draw on these stores of water and will compete with the rubber trees in dry weather.

Under mature rubber the leaf litter and the dense mat of roots of the trees themselves will protect the soil to some degree, but not as effectively as a good cover.

A final method of water conservation involves slowing down the rate of flow of runoff water by digging silt pits, contour terraces or contour trenches. The water that is held on these earthworks will naturally remain on top of the soil longer and therefore a greater proportion will penetrate to the lower layers.

In passing, it may be mentioned that rain water contains small amounts of nitrogen in forms that can be used by plants. Since rubber trees are usually short of nitrogen this is an additional reason why rain water should be conserved. The amount of nitrogen that can be saved in this way is small.

THE CONNECTION WITH SOIL CONSERVATION

A very close connection exists between the operations of soil conservation and water conservation. Cultural methods such as planting covers and digging contour terraces are now standard practice on most estates because they are recognised as necessary for the purpose of soil conservation. The only important measures that are done for the purpose of water conservation are mulching and the watering of nurseries or of young trees from water stored in streams or dams.

Mulching

THE WORD MULCH has a German derivation, meaning soft and beginning to decay. In agricultural practice, mulching now includes the application of any of a variety of materials to the surface of the soil around the stem of the growing plant, with a view to improving conditions for the root. Not always is the mulch the traditional mixture of moist organic residue and soil, for experience with many crops throughout the world has introduced special mulches for special purposes. In Hawaii, for example, a layer of paper along the planting rows of pineapples retains soil moisture and checks weeds, with a considerable increase in crop as a result. Such specific practices may not appear apposite to rubber planting, but the recorded observations of their effects under widely differing conditions all contribute to the fund of knowledge on which a scientific approach to the problem and practice of mulching can be based.

Mulching can benefit soil conditions in a variety of ways. A mulch protects the soil from extremes of temperature; in temperate climates market garden crops are thus protected from frost in order to force early growth. An example of the practice to reduce soil erosion is stubble mulching, extensively employed after the harvest in dry land farming. Mulching affords an important means of conserving water, not only by restricting evaporation but also by improving the permeability of the soil surface to rain; it is so used with tropical crops such as coffee and sugar cane to ameliorate drought. A layer of mulch will also suppress weeds.

The several distinct effects of mulching, which are exemplified above, all combine to benefit soil conditions for hevea, especially during the first year or so of its growth.

Choice of Mulch — Local estate conditions limit the choice of mulch, which should preferably be of soft tissued plant material. The ideal practice is to have enough legume to hand, so that it can be slashed and made ready for use without seriously damaging the stand of cover. This is not often possible, but the early establishment of a vigorous cover should be considered as a proposition whenever a replant is being planned. A good second choice is creepers such as *Mikania scandens* or *Passiflora foetida;* these may have to be brought in from outside the area and care may be necessary to prevent them from striking and establishing growth. A third choice of mulch is lalang and woody indigeneous materials. These lack the nutrient content of the others, nor will they improve the organic status of the soil so readily by their decomposition.

The beneficial effects of dead plant material for mulching are complex. The direct increase in soil water, due to simple physical causes, is but part of the picture. When the mulch decays easily, the initial reserves of soil fertility are augmented by mineral nutrients and organic matter washed down into the soil from the decomposing material. The absolute amounts of nutrients contributed in this way may be small, but they are readily available. Together with the extra organic matter and water, they have the effect of stimulating microbiological activity in

the soil and thus encourage the developing plant to root vigorously. After a while it often becomes difficult to decide where soil begins and mulch ends; their mixing results from the increased activities of earthworms, ants and other creatures, and the roots ramify throughout the whole. As long as the mulch is maintained the plant is assured of a favourable medium for rooting.

Mulching Young Rubber — The germinated rubber seedling depends greatly on conditions at the surface of the soil. Its root system consists of two distinct parts: a long taproot which rapidly grows down to a depth of several feet, and a collar of roots which grow out horizontally just beneath the surface. Mulching stimulates the growth of these surface roots and keeps them cool and moist so that they can feed on the nutrients already in the soil and those applied as fertilisers. This protection is not essential — witness the great number of successful plantings without mulching — but merits serious consideration, particularly on loose sandy or laterite soils which are liable to drought. Increased success in budding and uniformity of stand may justify mulching, even on soils which do not appear to require it. Stump planting may also benefit from mulching for similar reasons, although stumps have a greater rooting potential than do germinated seedlings.

Mulching is most necessary during the first twelve months of growth; after this period the rubber roots should be exploiting a large area of soil and so should be less sensitive to drought. Even then mulching along the weeded strips can promote good rooting conditions, suppress weeds, and minimise soil wash, but this practice is unlikely to be economical unless slashings from the cover crop are readily available.

Figure 1. A clean weeded plant, in comparative mulching experiment with clones RRIM 520 and LCB 1320, planted as budded stumps at our Experiment Station in 1952.

The suppression of weeds by mulching immediately around the growing plant obviates the need for scraping the soil, with the consequent danger of erosion and damage to the surface roots. *Figure 1* shows a plant in a clean weeded strip; the surface is sandy and changkol weeding of the bare soil has resulted in subsequent erosion and in the exposure of some of the roots. In comparison, *Figure 2* shows how the use of a mulch has developed a mound of rich soil, full of feeding roots, due to the conservation of soil and the addition of organic matter.

Figure 2. A mulched plant, from the experiment referred to in Figure 1. Lalang, mixed indigeneous growths, and mikania, were compared with clean weeding.

Mature Rubber – The wintering of a mature stand of rubber provides an annual fall of leaves to the ground. The thin cover of dead and decaying leaves returns mineral nutrients to the tree, either through the soil or directly to the surface roots which ramify through the layer of litter. There may also be some mycorrhizal effect.* This natural mulch keeps the soil surface cool and moist, and gives a good measure of protection from soil erosion.

Soil Type — When considering mulching, the soil type should be borne in mind. Easily decomposed material — legume creepers, mikania — should have a better effect than lalang on a soil which is not subject to drought but is deficient in nutrients and organic matter. On a soil with the moisture level as a limiting factor the two classes of material might well give similar improvements in plant growth. On deteriorated Indonesian estates, striking results have been obtained by covering the red laterite soil with a layer of cut lalang: the improved moisture conditions of the surface layers enabled the starved and dried out trees to develop an abundance of fresh strong roots.

Cut lalang can certainly assist the growth of hevea under conditions of drought, but our experiments to date show that it hardly equals mikania as a mulch for most purposes.

Mulching an Economic Proposition ? — Several considerations determine whether mulching is economically justified. The rate of girthing of young trees has been shown to be increased by mulching. By a judicious combination of mulching, manuring and good cultivation, the date of opening a rubber stand can be advanced. But the actual value of mulching is not easily assessed. Indirect benefits arising from weed suppression and from the protection against soil erosion in the clean weeded strip have to be taken into account. Other major factors are the availability of suitable material, and the frequency of replenishment of the mulch. We consider that since future performance depends so much on the successful establishment of the young trees, the use of mulches over at least the first year of growth is a good insurance policy.

* *An article explaining 'Mycorrhyza in Hevea' was published in Planters' Bulletin 12.*

Recent Advances with Latex

Chemical investigations have now reached a stage when results are constantly casting fresh light on the behaviour of latex. The following review of the work of our Chemical Division in this field over the past year will therefore be of interest to estates as indicating possible future trends in estate practice.

THE BROAD OBJECTIVE OF OUR RESEARCH on latex is to improve the control of concentrate preparation, with a view to producing latex of higher quality and greater uniformity. In this we pay particular attention to the need for retaining the foam rubber market, in competition with synthetic latex.

The properties of field latex and latex concentrate depend only to a small extent upon the rubber particles they contain; it is the non-rubber substances present in the serum and associated with the rubber globules that control behaviour. In consequence the chemistry, enzymology and microbiology of latex are fruitful fields for investigation, and are yielding much useful information on what substances are present in latex when it leaves the tree, how they change subsequently during storage and processing, and how these changes influence the properties of the latex concentrate finally obtained.

As well as these more fundamental approaches to the science of latex we are also seeking further empirical facts about latex itself, and we are applying our findings to industrial practice.

VARIABILITY

One important investigation at present in hand is a study of the variability of concentrate prepared with latex harvested at weekly intervals from a given block of mixed seedling trees at our Experiment Station. Observations include condition of trees, weather, bacterial content of latex and concentrate, enzyme activity of fresh latex, chemical analysis of latex and concentrate, technical properties of concentrate, molecular characteristics of the dry rubber, vulcanising behaviour of sheet from the field latex and of whole latex films, and so on. Nearly one hundred observations are made on each collection of latex. Simplified methods for statistical analysis of the data have been worked out and the observations are already yielding interesting results. The most surprising feature to date is the lack of variation in many of the properties examined. Not all properties remain constant however; thus enzyme activity, content of phosphorus, sulphur and manganese, molecular weight and vulcanising characteristics of the dry rubber have each shown significant variations during the past year. Recently the experiment has been extended to include latex collected from two clonal blocks (Tjir 1 and RRIM 501). The implication of this work is that lack of uniformity in field and factory procedures may be more important than seasonal changes in causing variability in commercial supplies.

PRESERVATION

Another problem to which considerable time has been devoted is the preservation of latex concentrate. A number of reasonably satisfactory systems have been worked out on an empirical basis, but only now are we beginning to learn the principles upon which sound preservation

must be based. Following our earlier work on preservation systems containing a bactericide, a sequestering agent and low ammonia, we have now investigated other combinations with low ammonia, as described in *Planters' Bulletin 24* (page 55). The most promising of the new systems at present is a combination of 0.2% boric acid and 0.05% lauric acid with 0.2% ammonia.

Preservation at the neutral point has also been studied. Partial success was obtained by centrifuging field latex containing 0.3% ammonia, neutralising the remaining ammonia with formaldehyde and adding a suitable detergent to give the required mechanical stability. This work has not been continued as there appears to be little consumer interest in neutral latex.

Physical means of sterilising field latex and concentrate, including irradiation with ultraviolet light and submission to ultrasonic vibrations have been demonstrated as feasible; we have to find out if such methods can be used in combination with preservations at reduced concentration in commercial practice.

EFFECT OF TEMPERATURE

It has long been known that latex concentrate continues to increase in mechanical stability for a number of months after preparation. This renders assessment of concentrate quality before shipment a difficult task, particularly as the consumer usually requires the properties to be within certain limits.

Recent experiments have shown that the rate of change in properties depends on temperature. Thus with tropical storage, at say 30°C, peak mechanical stability may not be reached for six months. At 40°C, however, it is reached in under 30 days, and at 50°C in a matter of five days. The maximum stability developed also depends on temperature and within the limits examined the higher the temperature of storage the lower the mechanical stability attained. There appears to be a reasonably good agreement between the stability reached after three months' storage at room temperature and that attained after five days at 50°C. This has been made the basis of an accelerated storage test for latex concentrates and forms a valuable guide for assessing the behaviour of a given concentrate at a later date.

The accelerated change in properties at higher temperatures has also been employed to produce a latex concentrate with much more constant properties. After heating at 80°C for a few hours, latex concentrates show a low mechanical stability, of the order of 100 seconds. This remains unchanged after storage for some months. By the addition of suitable stabilising agents, a concentrate showing the required mechanical stability and good behaviour on coagulation can be produced, with properties which remain reasonably constant over long periods. This work is not being followed up at present, owing to the problem of heating large bulks of concentrate at 80°C, which is a costly process.

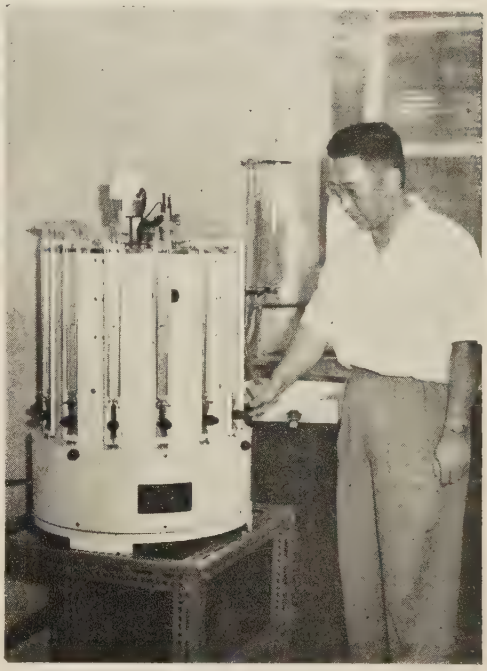
CHANGES ON STORAGE

On of the gravest defects of natural latex concentrate is the change in properties which continue for an indefinite period after concentration. The reactions involved are complex and a complete understanding of

the changes involved will not be attained for a number of years; even so, we are now beginning to recognise some of the responsible factors.

Recent work has confirmed earlier findings that availability of oxygen is a most important factor in controlling the rate at which mechanical stability increases. The presence of gaseous oxygen, peroxides or other oxidising agents markedly increases the rate, whereas lack of gaseous oxygen and the presence of reducing agents (which absorb oxygen) each has a retarding influence. It has been demonstrated that in any one latex concentrate the amount of soap forming fatty acid increases on storage along with the mechanical stability. On the other hand no correlation can be established between the amount of soap forming acid present and the mechanical stability of a series of latices from different sources. By modifying the availability of oxygen, the mechanical stability developed by a given concentrate can be changed within limits but the amount of soap forming fatty acid liberated does not appear to be influenced.

We are now attempting to correlate oxygen absorption with the development of mechanical stability, and the soap forming propensity of naturally occurring acids. The role of proteins in conferring mechanical stability is also being studied.



Warburg apparatus used in the study of enzymes in latex at the research laboratory on our Experiment Station, Sungei Buloh.

MECHANISM OF COAGULATION

Another aspect of our work on latex is the study of coagulation, in which we are seeking the mechanism by which latex particles come together and build up the structure of normal coagulum. This investigation is of importance in processes where rapid coagulation is required, for example in continuous methods of converting latex to dry rubber; it may also throw light on the factors controlling the drying of sheet rubber. A special instrument called a torsiometer has been constructed to follow the process of coagulation. Experiments have been carried out in the presence of a preservative in an attempt to avoid complications due to putrefaction.

The coagulation of lightly ammoniated field latex was found to depend on temperature; within the range 14° to 65°C, the higher the temperature the more rapid the coagulation and the tougher the coagulum formed. Storage of the latex for a few hours at the test temperature before coagulating enhanced the effects observed. At temperatures above 70°C, the rate of apparent coagulation was reduced and even fell to zero. Under these conditions the rubber globules appear to flocculate, and do not form a coherent coagulum. Exposure for even a few seconds to a temperature of 90° to 100°C destroys the power to form a coherent coagulum.

The effect of formaldehyde as a preservative instead of ammonia was then studied. Immediately after adding 0.1% formaldehyde coagulation appears to be promoted but after some time a flocculant precipitate may be formed instead of the usual coherent coagulum. The time taken to pass from one stage to the other depends upon a number of factors, including temperature and the concentration of formaldehyde. At room temperatures (say 28° to 30°C), the initial stage takes some hours to complete; at temperatures above 45°C the initial stage is completed so swiftly that it often escapes detection.

We hope to carry out further experiments on field latex containing no preservative. This presents considerable difficulty, as the latex and equipment must be kept free from bacterial infection. Means of collecting sterile latex in adequate quantities are now being examined.

The final objective of our investigations is for producers to take our findings and put them into daily use. We are very grateful to those estates and factories who cooperate with us in testing out our methods on a commercial scale and in establishing their industrial value.

R. R. I. News

A letter entitled 'Zinc-deficiency of *Hevea brasiliensis* as a Predisposing Factor to *Oidium* Infection', by Dr E.W. Bolle-Jones and Mr R.N. Hilton, has appeared in the scientific journal *Nature*. Aspects of this study of interest to our readers were presented in *Planters' Bulletin 23*.

o

A ready reckoner for predicting total weight of dry rubber, given d.r.c. and bulk of latex, is available in the form of a table mounted on stiff card, 18 inch × 14½ inch, and suitable for factory use. The range is up to 40 gallons, with steps of one pint. *Available on request, price $1.50 post free in Malaya.*

Further spraying trials have confirmed that, unlike other common grasses, *Ischaemum muticum* is more effectively controlled by sodium chlorate than by sodium arsenite.

o

The Plant Protection Agreement for South East Asia and Pacific Region came into force in July 1956 with the signatures of nine governments.

Termite Control

Our article 'Termites' in *Planters' Bulletin 19* lists aldrin, dieldrin and chlordane as soil insecticides that effectively protect trees against termite attack. Their persistence in soil has now been

under investigation for nearly four years. Two methods have been used. Firstly, soil samples have been taken for testing from around treated trees in the field. In the earliest test the quantity of insecticidal solution applied at each planting point was two gallons of a stronger concentration than is recommended for general use; the last test started nearly two years ago, employed a pint only, of a weaker concentration than that recommended. All the treated soils are still toxic to termite workers placed in them.

The second method of test was by exposing pots of treated soil of various types to weathering, taking samples at intervals and leaving termite workers in them for two hours only and observing their survival in untreated soil. Persistence of the chemicals has been found to be little affected by soil type, but all the insecticides were soon lost from or inactivated by peat. This second method of test, which is more sensitive than the first, has also shown chlordane to be less persistent than aldrin or dieldrin. Aldrin, being the cheaper of the two, therefore emerges as the preferred material for termite control.

Rhizobium Compost Cultures

Our Pathological Division distribute, on request, cultures of *Rhizobium* for inoculating seed of legume covers. The procedure is described and explained in the article 'Establishing a Legume Cover' in *Planters' Bulletin 14*. Hitherto the bacteria have been distributed as agar cultures, the culture tubes and boxes in which they are packed being returnable. From now on we shall supply instead a *Rhizobium* compost culture, packed in polythene bags.

The strain most supplied is one which is effective on *Centrosema pubescens, Pueraria phaseoloides* and *Calopogonium mucunoides* and which can therefore be used on any of these three common covers alone, or on mixtures. Cultures are best used fresh but they can be stored satisfactorily for a week or two in a dark place which is cool but not refrigerated.

The method of using the compost culture differs from the previous procedure only in the way of making the bacterial suspension, which is simply by stirring the contents of the packet in a pint of water. This is sufficient for twenty pounds of seed. Formic acid serum from the coagulating tank, recommended as slightly superior to water as a medium in which to suspend the bacteria, can be used if it is readily available. The results with ordinary water are perfectly satisfactory, however.

After hot water treatment to promote rapid germination (described in the article in *Planters' Bulletin 14*) drain the seed thoroughly, as by spreading it over a piece of cloth. For inoculation place it in a clean container and pour the bacterial suspension over it, stirring gently so that the whole mass is wetted. Excess liquid that drains to the bottom can be poured over again, but the seed should not be roughly handled as the softening of the seed coat brought about by the hot water treatment renders some of the seed liable to injury. Spread the inoculated seed in a thin layer to dry, superficially only, away from direct sunlight. Plant it as soon as possible afterwards,

mixed with an equal weight of Christmas Island rock phosphate.

Experiments carried out in the laboratory in the course of developing the compost culture have shown that one gram of this material is about equivalent to one tube of agar culture. Because the compost can more readily be prepared in bulk, we are packing ten times as much into the bag that is to replace one of the old culture tubes. The procedure for inoculating legume seed has always been designed to add the bacteria in numbers greatly in excess of the minimum needed to bring about nodulation in test pots. For field plantings the excess is most desirable, to allow for the competition of microorganisms already present in the soil. With the introduction of *Rhizobium* compost cultures the amount of inoculum will be greatly increased, while the user will be saved expense and the trouble of returning packages to us.

Correspondence

The Editor invites letters of general interest for publication in this column. Comment and queries arising from articles recently published will be welcome. The name and address of the writer must be given in full, but may be withheld from publication if desirable.

o

FERTILISER NOMENCLATURE

We have read the Editorial in *Planters' Bulletin 24* on the need for simplifying fertiliser nomenclature, and agree wholeheartedly. No doubt the other parties concerned directly would also be in agreement.

As you say, there has been considerable agitation in Europe and North America for the contents of a fertiliser to be expressed in terms of the element rather than the oxide. However, in both these areas the situation is so complex that it is doubtful whether anything can be done except by government decree. Here in Malaya we have an entirely different situation in that the fertiliser market is still as yet quite small and any change toward simplification would assist in the appreciation of modern scientific agricultural practices.

We consider that the proposed change is most desirable and should be made as soon as possible. If necessary it could be done gradually, thus for a period of one year the content of all fertilisers could be expressed as both the oxide and the element. After this trial period all fertiliser analyses would be expressed only as the element. We would prefer a complete change, however. We foresee no difficulty provided the fertiliser companies, the R.R.I. and the Department of Agriculture agree, and decide on the date when the change is to be made.

Malayan Fertilisers Ltd

M.A. Wesley

Advisory Officer

We are seeking the views of interested parties and hope to secure agreement for action before the end of the year. If we obtain unity within Malaya, we shall presumably be committed to two systems in our dealings with other countries. This state of affairs may well persist for longer than the year suggested.—Editor

Future Clonal Seedlings

The stands of budgrafted clones commonly planted before the war have provided many of the seedlings now used as stocks and, from clone Tjir 1, the bulk of the clonal seed for current replanting programmes.

Today other clones are extensively planted on a large and medium scale which were not current then; for instance RRIM 501, RRIM 513, RRIM 526, PR 107, LCB 1320, PB 5/51 and PB 5/63. It is important to discover if the selfed seed collected from the centres of monoclone blocks of these clones, or illegitimate seed from contact belts between the more common clones, will provide high yielding clonal seedling families or vigorous stocks for budding. Such areas will provide much of the seed in the future.

Although these clones are represented on the R.R.I. Experiment Station, they are mostly in half acre plots in clone trials; thus cross pollination is likely and the illegitimate seed collected in these areas will not be typical of seed from ordinary commercial plantings. The Botanical Division are anxious to hear from estates with monoclone areas of modern budgrafts, from which they may collect seeds for trial. Managers are requested to send details of monoclone areas which are now bearing seed. Since field trials take time, the potential value of seed collected from the currently planted clones needs investigation as soon as possible.

Planters' Bulletin—Back Issues

We recommend new subscribers to obtain a set of recent back issues. From January 1955 to date, *Planters' Bulletin 16* to *26* is available for $5.50. Add postage, if outside Malaya. The amount can be debited against your deposit account, provided this is in funds. If it is not, kindly remit a further $10. If you are oversea, you may find it convenient to remit $20 (Malayan) or more, to avoid the need for frequent drafts in foreign currency. We send you an annual statement of account.

Other useful issues of *Planters' Bulletin* are those containing the annual indexes, *Planters' Bulletin 3, 9* and *15*. These are still available, at the usual price of 50 cents each.

We can provide a special temporary binder for $5 post free in Malaya. A dozen issues can readily be inserted one by one, as they arrive. This binder keeps recent issues in good condition for permanent binding in due course, when a sufficient number has been accumulated.

Unless you have a deposit account,
Please remit with your order

OUR COVER SHOWS AN AERIAL VIEW OF THE LABORATORIES AND OFFICES OF THE RUBBER RESEARCH INSTITUTE, AMPANG ROAD, KUALA LUMPUR.

Printed for the Board of the Rubber Research Institute of Malaya by
The Standard Engravers & Art Printers, 63 Campbell Road, Kuala Lumpur
Selangor